Code No: Z0321 / R07 **Set No. 1**

I B.Tech - Regular Examinations, June 2009
CLASSICAL MECHANICS
(Common to Mechanical Engineering, Chemical Engineering, Mechatronics, Production Engineering and Automobile Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Replace the given system of forces acting on a body as shown in figure 1 by a single force and couple acting at the point A. [16]

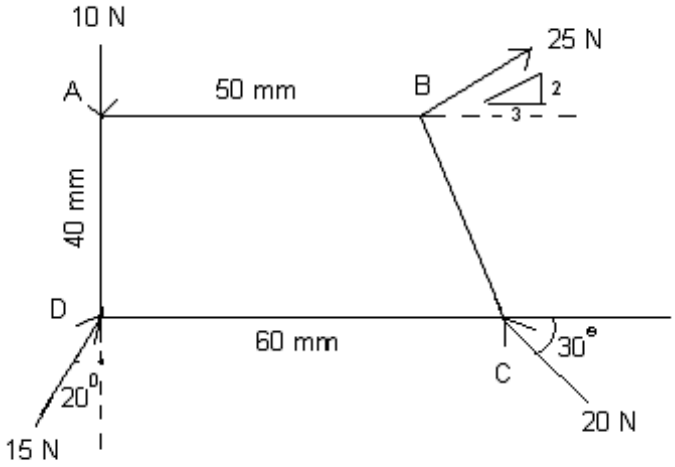

Figure 1

2. A force F with a magnitude of 150 N is applied at the origin O of the axes x, y and z as shown in Figure 2. The line of action of F passes through a point A whose co-ordinates are 2 m, 4 m and 6 m. Determine
   (a) the x, y, and z scalar components of F
   (b) the projection of F on x-y plane, and
   (c) the projection of F along the line OB. [16]

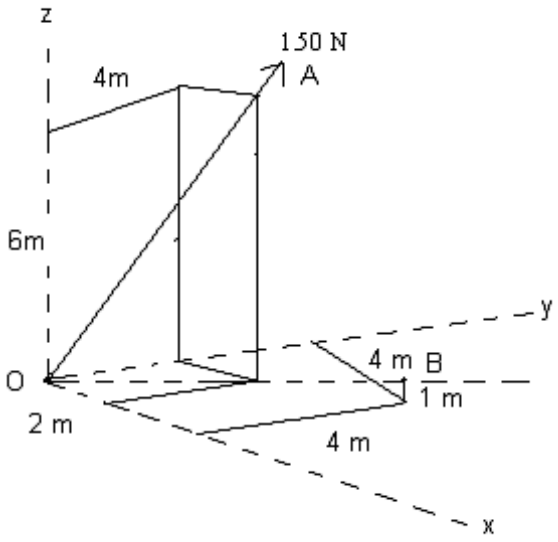

Figure 2

3. Find the centroid of the plane area shown in figure 3. [16]

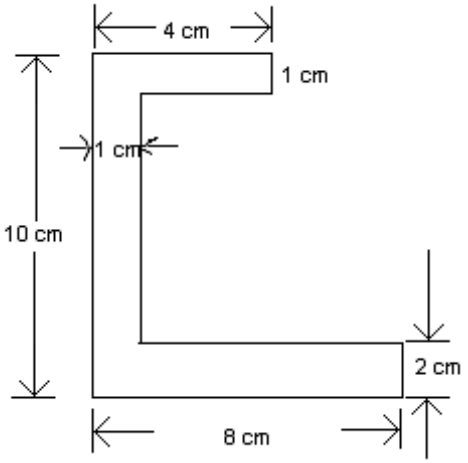

Figure 3

4. Find the moment of inertia of the plane area shown in figure 4 about X and Y axes through its centroid. [16]

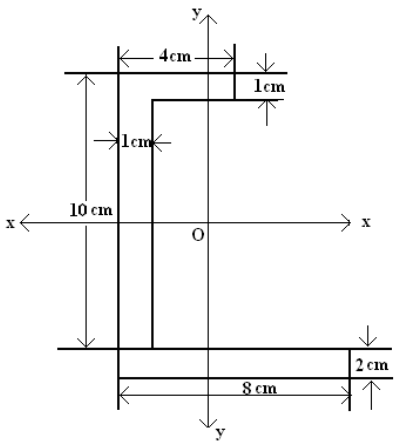

Figure 4

5. Calculate the forces induced in the members of the pin-jointed truss shown in figure 5. Show the values on a neat diagram of the truss. Tabulate your results. [16]

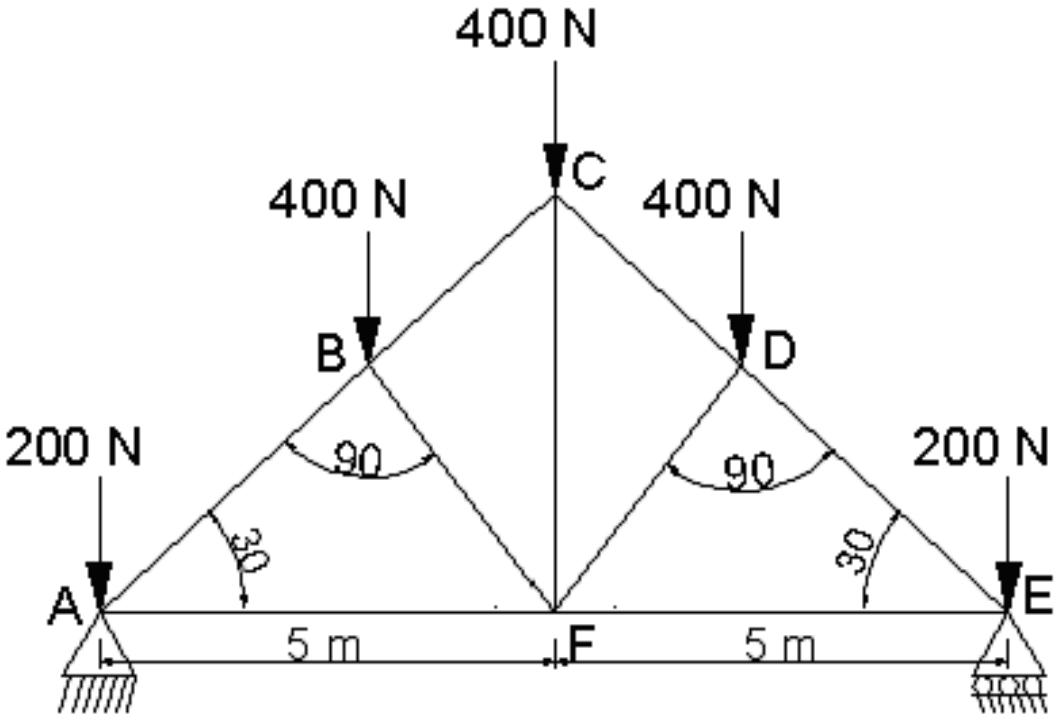

Figure 5

6. A train weighing 1900 KN without the locomotive starts to move with contact acceleration along a straight horizontal track and in the first minute acquires a velocity of 50 kmph. Determine the tension S in the draw bar between the locomotive and train if the total resistance to motion due to friction and air resistance is constant and equal to 0.005 times the weight of the train. [16]

7. (a) What is the advantage of work-energy theorem?
   (b) A shaft of radius r rotates with constant angular speed ω in bearings for which

are coefficient of friction is μ. Through what angle ϕ will it rotate after the driving force is removed? [4+12]

8. (a) A 1.2 kg block is supported by a spring of constant k = 200 N/m which can act in tension or compression. The block is struck by a hammer from equilibrium position which imparts to block an upward velocity of 2 m/sec. Determine: the position, velocity and acceleration of the block 0.90s after it has been struck by the hammer.

   (b) The elongation of a uniform metal rod of diameter 0.9 cm, is S = WL/AE. One end of the rod is fixed, other end is loaded. L = 45 cm, E = 200 $\times 10^6$ kPa. Determine

      i. the equivalent spring constant of the rod

      ii. the frequency of the vertical vibration of a block as weight W = 7.3 kg attached to one end of the rod. [8+8]

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Code No: Z0321 / R07 **Set No. 2**

I B.Tech - Regular Examinations, June 2009
CLASSICAL MECHANICS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Replace the given system of forces acting on a body as shown in figure 1 by a single force and couple acting at the point A. [16]

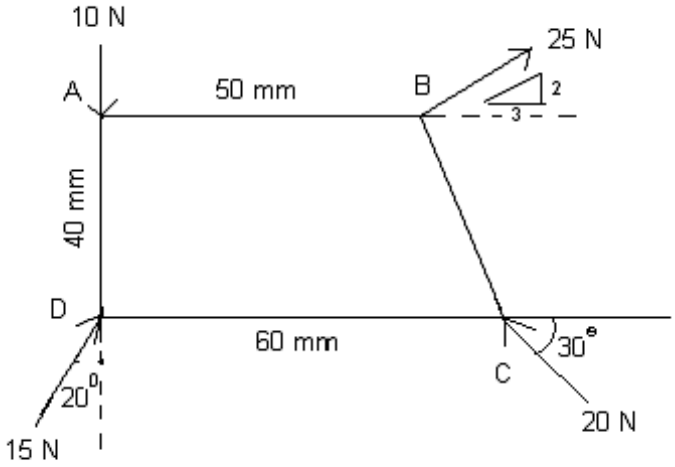

Figure 1

2. Determine the magnitude of F_1 and F_2 for the following system of forces which are in equilibrium as shown in figure 2. [16]

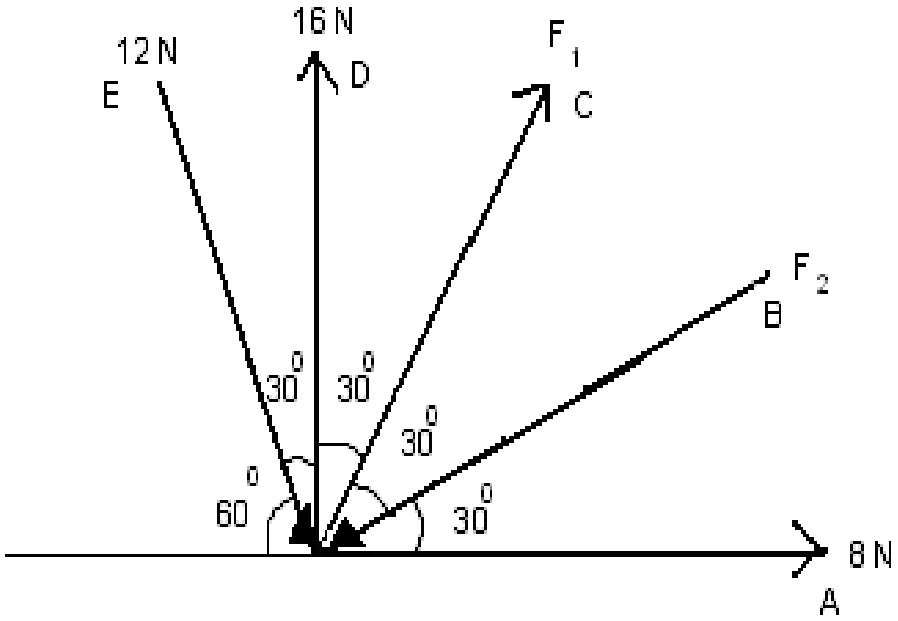

Figure 2

3. Determine the volume of the body shown in figure 3 using Pappus-Guldinus theorem.

[16]

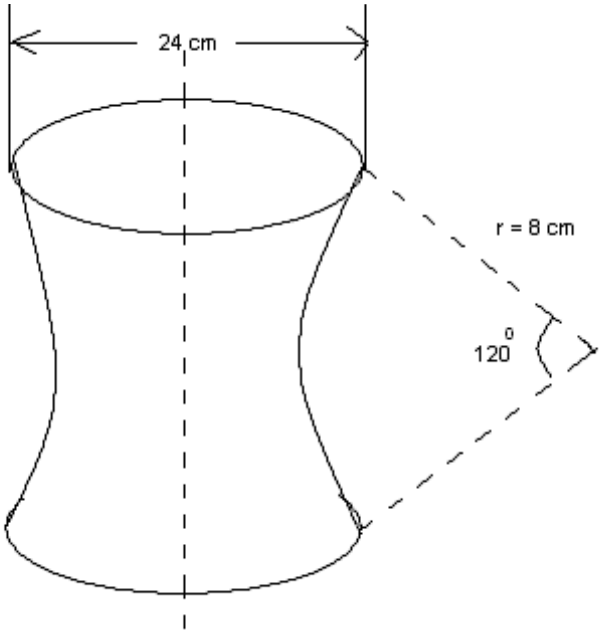

Figure 3

4. Determine the moment of inertia about the horizontal axis through the centroid of the section shown in figure 4. [16]

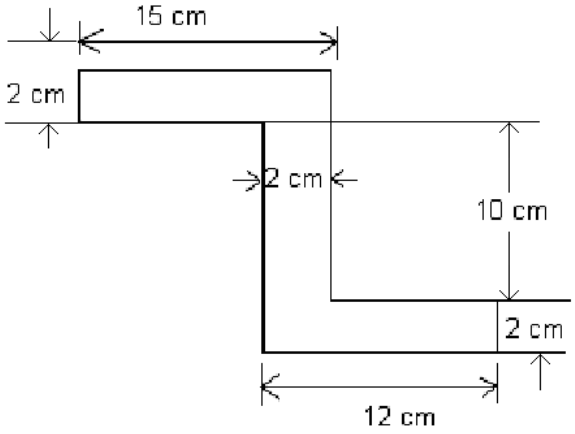

Figure 4

5. An inclined truss shown in figure is loaded as shown in figure 5. Determine by the method of joints the nature and magnitude of the forces in all the members of the truss. [16]

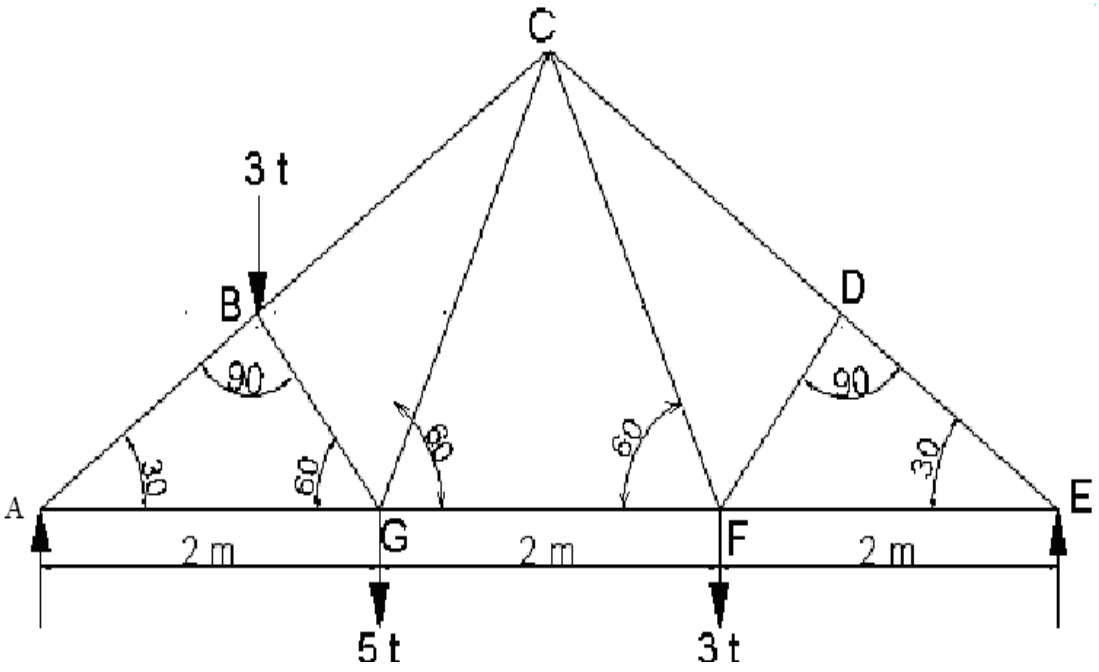

Figure 5

6. (a) Define Newton's second law of motion.
   (b) A 6 kg block B starts from rest and slides on the 14 kg wedge A, which is supported by a horizontal surface. Neglecting friction, determine
      i. the acceleration of the wedge
      ii. The acceleration of the block relative to the wedge as shown in figure 6. [2+14]

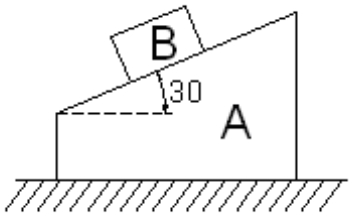

Figure 6

7. A 900 kg car starts from rest at 1 and moves without friction down the track shown in figure 7.

   (a) Determine the force exerted by the track on the car at point 2, where the radius of curvature of the track is 5m

   (b) Determine the min. safe value at the radius of curvature at point 3. [16]

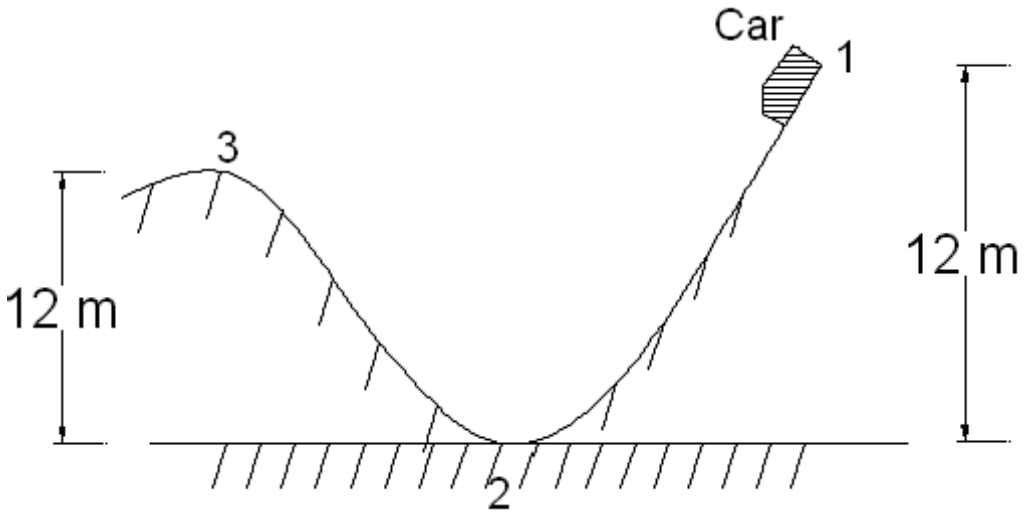

Figure 7

8. The central deflection of a simply supported beam with a central point load is given by S = PL^3 / 48EI. Where L = 5 M, E = 2 $\times 10^5$ N/mm^2, I = 1.73 $\times$ 10^{-5} m^4. The beam is of uniform cross section with a static load "P". Determine

   (a) equivalent spring constant of the beam

   (b) the frequency of vibration of a 60kg block attached to the centre of the beam. Neglect the mass of the beam and assume that the load remaining in contact with the beam. [16]

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Code No: Z0321 / R07 **Set No. 3**

I B.Tech - Regular Examinations, June 2009
CLASSICAL MECHANICS
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Replace the given system of forces acting on a body as shown in figure 1 by a single force and couple acting at the point A. [16]

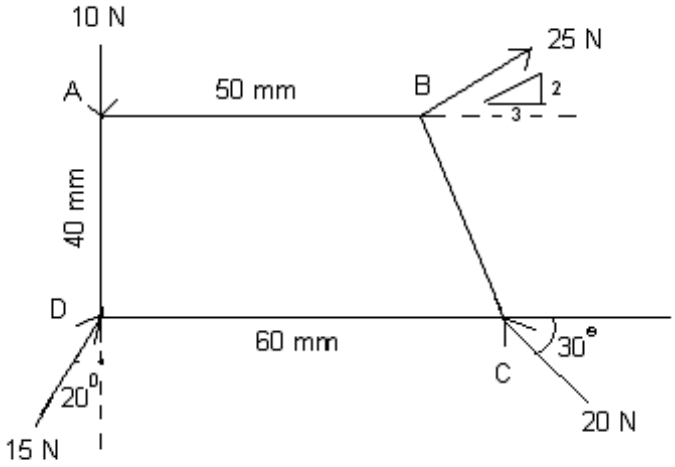

Figure 1

2. Five strings are tied at a point and are pulled in all directions, equally spaced, from one another. If the magnitude of the pulls on three consecutive strings is 70 N, 40 N and 55 N respectively, find graphically the magnitude of the pulls on two other strings, if the system is in equilibrium. [16]

3. Find the centroid of the area shown figure 3. [16]

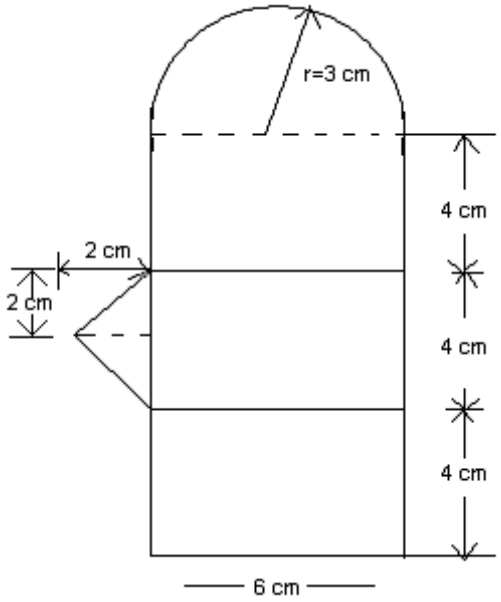

Figure 3

4. Find the moment of inertia of the built-up section shown in figure 4 about the centroidal X and Y axes. [16]

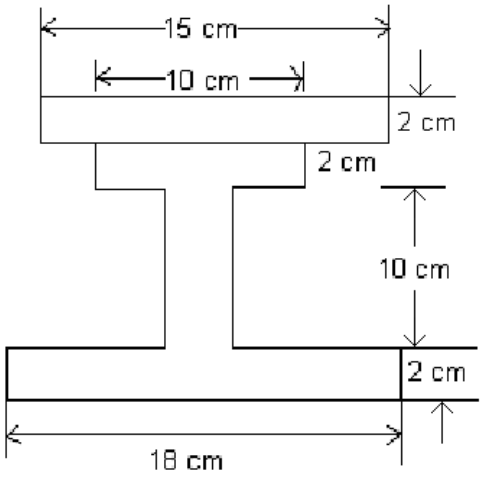

Figure 4

5. Find the members forces in a structure shown in figure 5. [16]

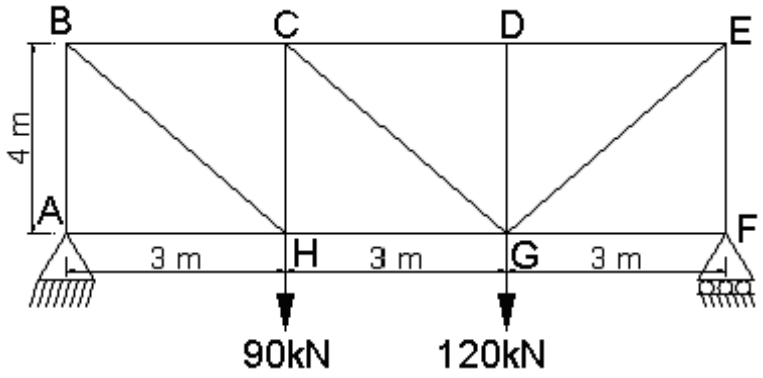

Figure 5

6. (a) Explain the concept of coriolis acceleration.

   (b) Show that there are two directions in which a particle may be projected at the same velocity so that it passes through a given target. Establish the minimum velocity of projection requirement such that the particle does reach the target. [6+10]

7. A car of weight 2100kg starts from rest at point A on a 6^0 incline travels coasts through a distance of 140m to point B. The brakes are then fully applied, causing the automobile to skid to a stop at point c, 18m from B. The coefficient of dynamic friction between the tires and the road is 0.75, determine the work done on the automobile by the combined effects of air resistance and rolling resistance between points A and C. [16]

8. A 5 kg block, attached to the lower end of a spring whose upper end is fixed, vibrates with a period of 6.5s. The spring constant k is inversely proportional to its length, determine the period of a 2.5 kg block which is attached to the center of the same spring if the upper and lower end of the spring are fixed. [16]

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Code No: Z0321 / R07 **Set No. 4**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. A rod AB shown in Figure 1 is held by a ball and socket joint at A and supports a mass C weighing 1200 N at end B. The rod is in x-y plane and is inclined to y axis at an angle of 15^0. The rod is 10 m long and has negligible weight. Find the forces in the cables DF and EB. [16]

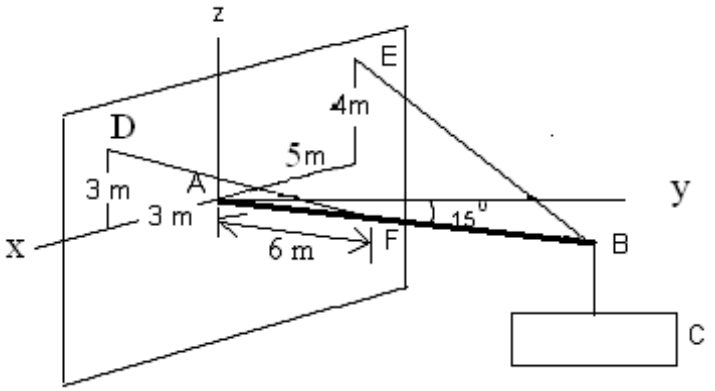

Figure 1

2. A pendulum ABCD has three bars each 3 m in length and weighing 35 kN as shown in Figure 2. It is held in equilibrium by applying a horizontal force of 10 kN at the free end. Determine the angles θ_1, θ_2 and θ_3 made with the vertical. [16]

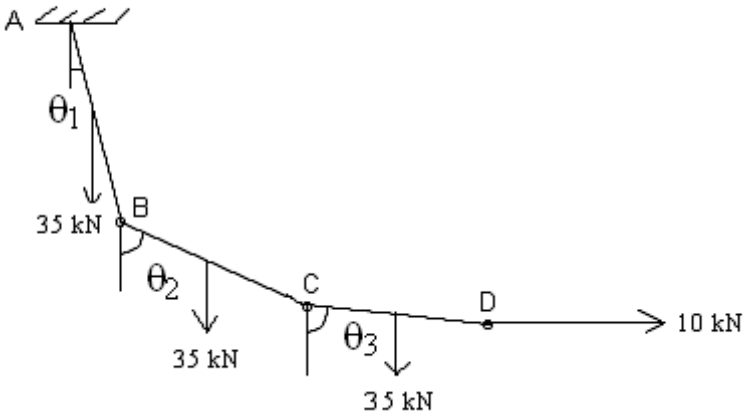

Figure 2

3. Find the centroid of the area shown figure 3. [16]

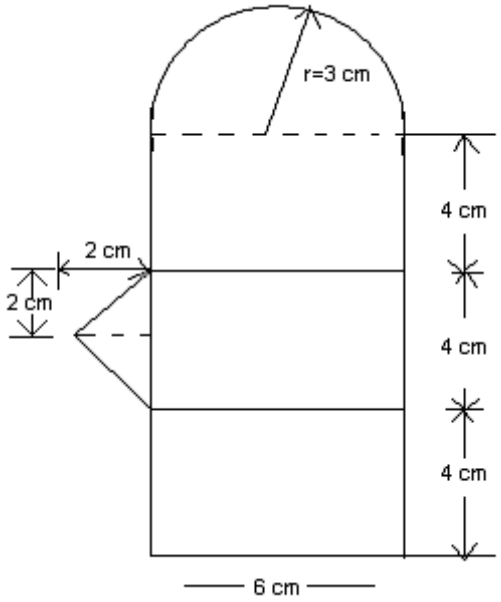

Figure 3

4. Find the moment of inertia of the plane area shown in figure 4 about X and Y axes through its centroid. [16]

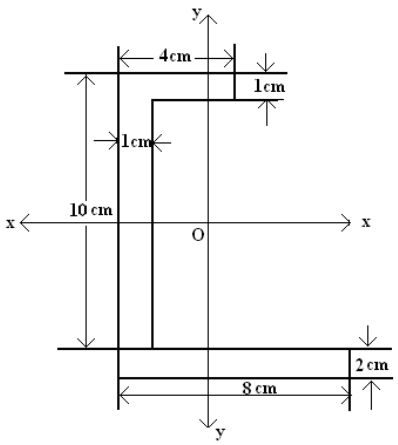

Figure 4

5. Find the members forces in a structure shown in figure 5. [16]

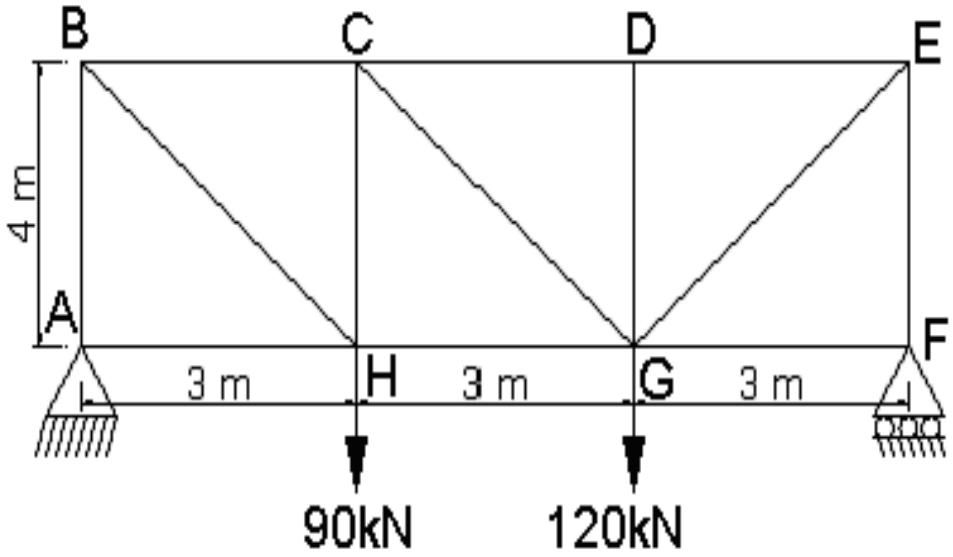

Figure 5

6. (a) The motion of the particle is defined by the relation x = $6t^4$ + $8t^3$ - $14t^2$- 10t + 16, where x and t are expressed in meters and records, respectively. Determine the position, the velocity, and the acceleration as the particle when t = 3s.

   (b) A car is tested for acceleration and braking. In the street - start acceleration test, the elapsed time is 8 seconds for a velocity increase from 8 km/h to 80 km /h. In the braking test, the distance traveled is 40m during braking to a stop from 80 km / hr. Assuming constant values of acceleration and deceleration, determine

      i. the acceleration during the street - start test

      ii. the deceleration during the braking test. [8+8]

7. (a) A homogeneous sphere of radius r = 250mm and weight W = 450N. Can rotate freely about a diameter. If it starts from rest and gains, with contact angular acceleration an angular speed N = 175rpm in 12 revolutions find the acting moment M.

   (b) How do you define the velocity and acceleration of a rigid body in plane motion? Explain work, power ans energy. [8+8]

8. The central deflection of a simply supported beam with a central point load is given by S = PL^3 / 48EI. Where L = 5 M, E = 2 $\times 10^5$ N/mm^2, I = 1.73 $\times$ 10^{-5} m^4. The beam is of uniform cross section with a static load "P". Determine

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